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3,291,948

ORIFICE STRUCTURE FOR COMPRESSED GAS-CIRCUIT INTERRUPTER

Filed Aug. 6, 1964

3 Sheets-Sheet 1

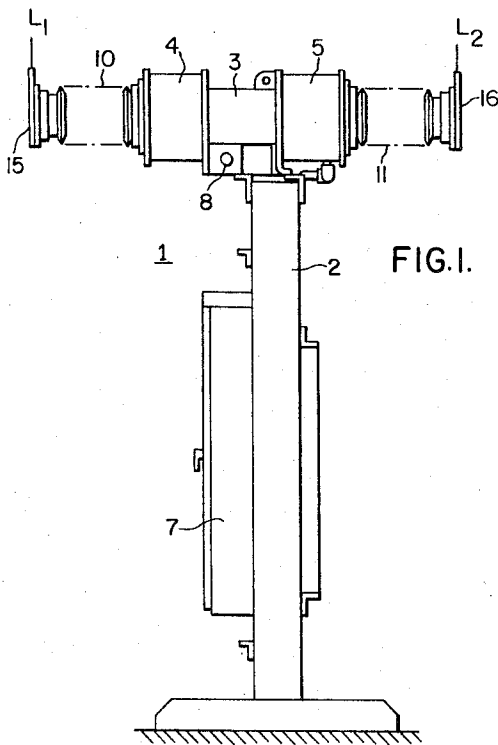


FIG. 1.

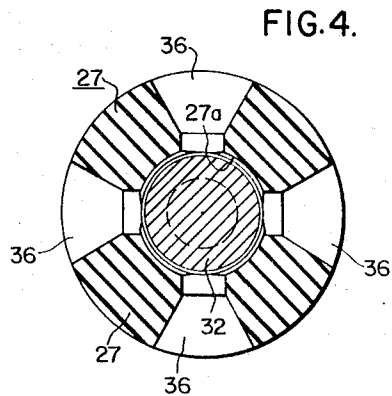


FIG. 4.

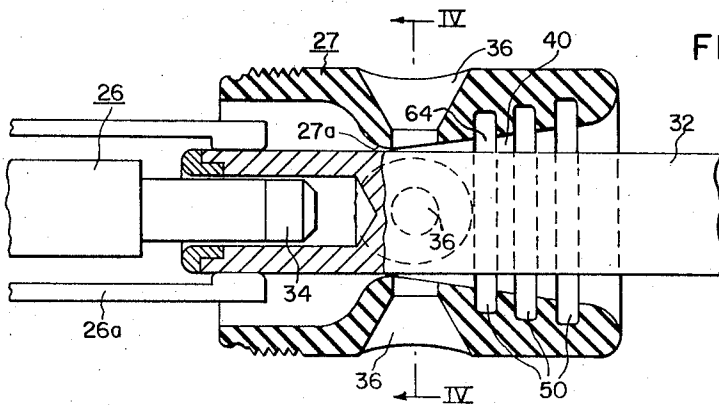


FIG. 3.

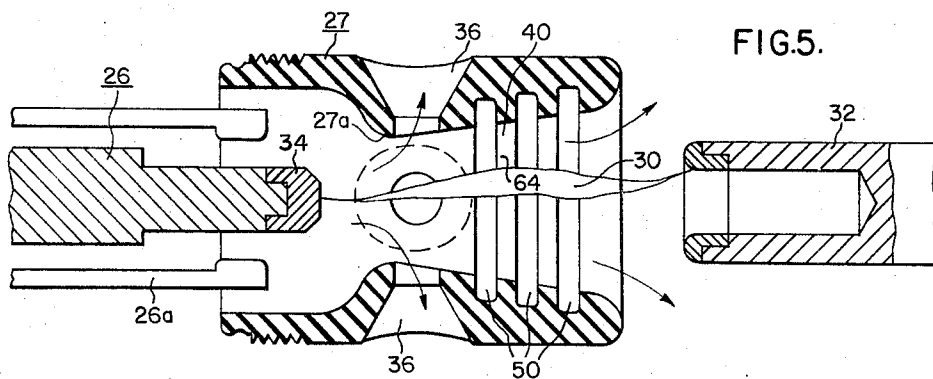


FIG. 5.

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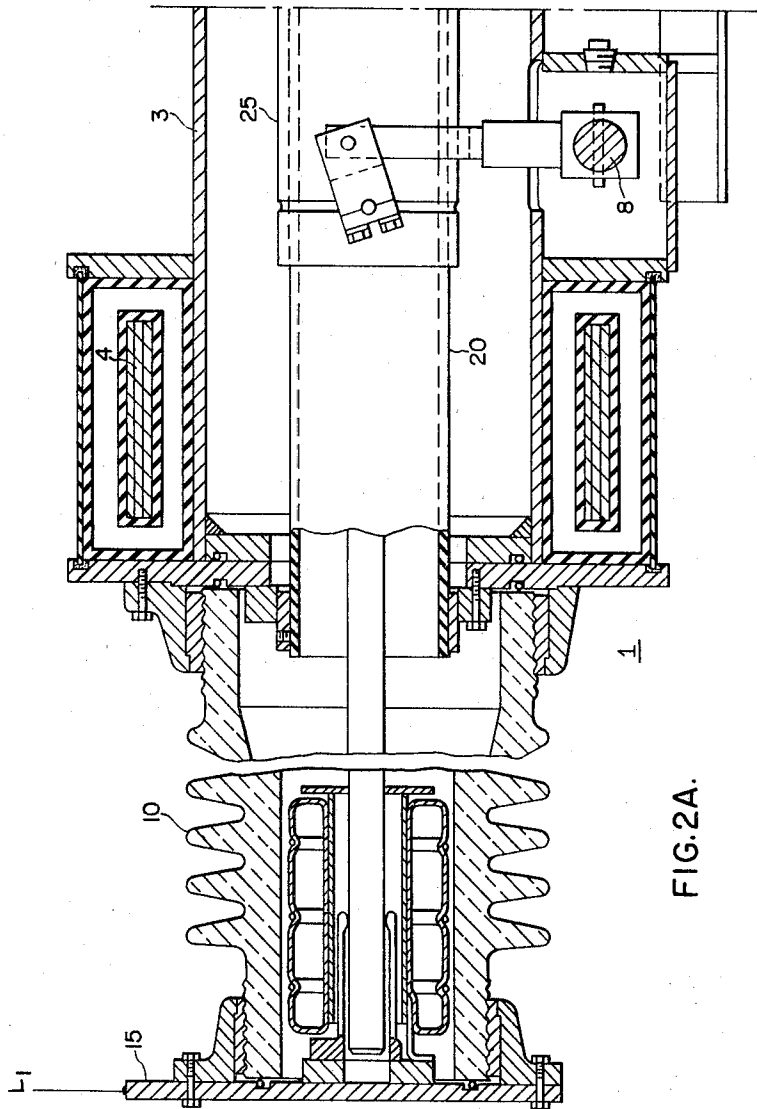


FIG. 2A.

WITNESSES

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3 Sheets-Sheet 3

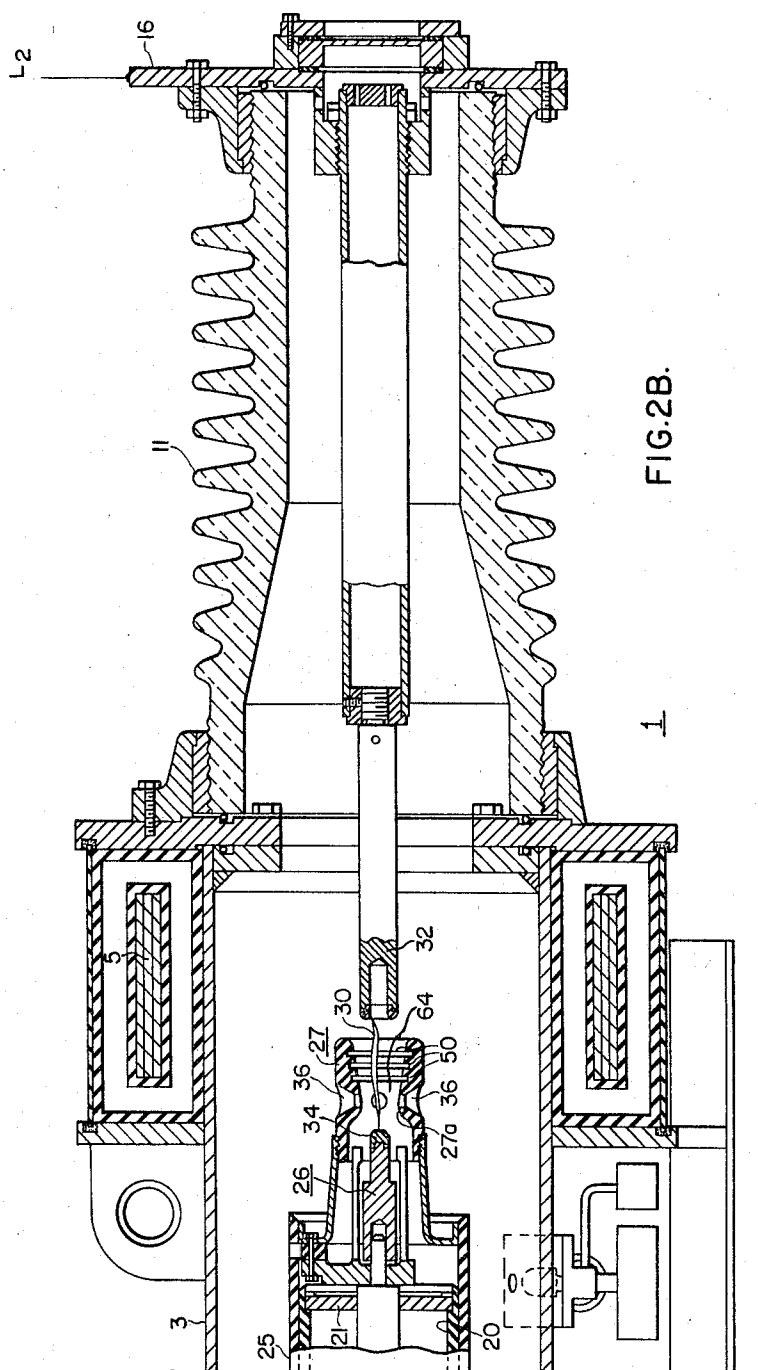


FIG. 2B.

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ORIFICE STRUCTURE FOR COMPRESSED GAS-CIRCUIT INTERRUPTER

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6 Claims. (Cl. 200-148)

This invention relates to improved orifice structures for compressed-gas circuit interrupters, and, more particularly, to improved orifice constructions to more effectively direct gas flow through such orifice structures into intimate engagement with the established arc.

A general object of the present invention is to provide an improved insulating orifice structure for a compressed-gas type of circuit interrupter.

A more specific object of the present invention is to provide an improved orifice structure for a compressed-gas circuit interrupter in which the orifice structure is movable, and in which the relatively stationary contact structure, in effect, forms a restriction through the orifice opening prior to withdrawal of the movable orifice structure from the stationary contact to thereby effect venting therethrough.

In accordance with one aspect of the present invention, an insulating orifice member is provided with a plurality of radially-extending venting holes disposed on the downstream side of the orifice restriction. In addition, for withstanding the maximum impulse voltage breakdown across the separated contact gap during the opening operation, and in the breaker open position, it is desirable to provide a plurality of spaced grooves, or ribs adjacent the outer free end of the orifice structure.

Further objects and advantages will readily become apparent upon reading the following specification, taken in conjunction with the drawings, in which:

FIG. 1 is a side elevational view of a three-pole puffer-type circuit interrupter;

FIG. 2 is a longitudinal vertical sectional view taken through one of the pole-units of the circuit-interrupting structure of FIG. 1, the contact structure being in the partly open-circuit position;

FIG. 3 is a considerably enlarged longitudinal sectional view taken through the improved orifice structure of the instant invention;

FIG. 4 is a sectional view taken substantially along the line IV-IV of FIG. 3; and,

FIG. 5 is a vertical sectional view, somewhat similar to FIG. 3, but showing the gas flow conditions during arc interruption.

Referring to the drawings, and more particularly to FIG. 1 thereof, the reference numeral 1 generally designates a three-phase circuit-interrupting structure comprising a plurality of laterally-spaced pole units, the end one of which is illustrated in FIG. 1. As shown, an upstanding grounded framework 2 supports a centrally-disposed metallic housing 3 having a pair of current-transformer structures 4, 5 surrounding the same, as more fully illustrated in FIG. 2 of the drawings.

As shown in FIG. 1, a mechanism compartment 7 is provided having disposed interiorly thereof a suitable operating mechanism for effecting opening and closing rotative movement of an operating shaft 8 (FIG. 2), which interconnects the several pole-units, and consequently causes simultaneous contact motion within the individual pole-units. With particular reference to FIG. 2, it will be noted that jutting laterally from the generally centrally-disposed grounded mechanism housing 3 is a pair of insulating casing members 10, 11 supporting terminal structures 15, 16 adjacent opposite ends thereof. Fixedly supported interiorly of the mechanism housing 3 is a sup-

port pedestal 20 preferably composed of insulating material, and having a fixed piston 21 associated therewith adjacent the right-hand end thereof. Movable, in sliding fashion, over the insulating pedestal 20 is an operating cylinder 25 carrying a movable contact structure 26 and a movable orifice structure 27, the latter being more fully illustrated in FIGS. 3 and 4 of the drawings.

From an inspection of FIG. 2 it will be apparent that counterclockwise rotative motion of the operating shaft 8, as effected by the mechanism disposed interiorly of the mechanism compartment 7, will effect leftward opening movement of the operating cylinder 25 and consequently a compression of the gas disposed between the fixed piston 21, and the orifice structure 27. The compression of this gas causes the ejection thereof out through the orifice structure 27 and into intimate engagement with the arc 30, the latter being established between a relatively stationary contact 32 and a centrally-disposed movable arcing contact 34. The axially-flowing blast of compressed gas, such as sulfur-hexafluoride (SF_6) gas, will effect extinction of the arc 30 within the orifice structure 27.

It will be noted that the diameter of the relatively stationary contact 32 is such as to substantially restrict the orifice opening 27a, and to prevent any flow of gas there-through until the movable orifice structure 27 has pulled away therefrom permitting the annular venting area 64 to come into play.

It has been discovered that the provision of lateral radially-disposed vents 36 situated on the downstream side 40 of the orifice restriction 27a considerably facilitates circuit interruption. For example, it has been experimentally observed that an interrupting rating of 18,000 amperes with a conventional-type orifice has been increased to 20,000 amperes, roughly a 10% improvement, by providing the lateral vents 36 and locating them on the downstream side 40 of the orifice 27. The exact theory pertaining to the interruption process is not clearly understood, it being conceivable that on low-current interruption, a suction or aspirating effect is achieved by actually drawing gas inwardly through the venting holes 36, into the arcing region whereas on high-current interruption, the additional venting area 36 provides relief for an explosive venting of the compressed gas. In any event, the improved interrupting structure 27, as illustrated in FIGS. 3 and 4, has increased the interrupting rating of a puffer-type circuit interrupter 1 approximately 10%.

To provide an increased impulse voltage breakdown across the separated contact gap in the open position, there are provided a plurality of spaced grooves, or ribs 50, more clearly illustrated in FIG. 3 of the drawings. These grooves not only increase the impulse voltage breakdown across the separated gap, but may have a very desirable interrupting benefit by creating more gas turbulence, and lengthening of the established arc 30.

It has been discovered as a result of theoretical considerations, confirmed by actual tests, that considerably improved results are achieved by the use of a least four round lateral symmetrically-positioned venting holes 36 having a cumulative venting area substantially equal to one-half that of the area through the restricted throat 27a of the orifice structure 27. In addition, it was discovered that the venting holes 36 should be as close as possible to the orifice restriction 27a, as shown in FIG. 3, without burning the material of the orifice restriction. In addition, the venting should be provided substantially uniformly outwardly, and a minimum of four round venting holes 36 should be provided for the best results. Elongated slots, or holes only on one side of the orifice, or two lateral holes only, proved to be ineffective. A minimum of four holes 36 were required.

During the closing operation, clockwise rotative move-

ment of the operating shaft 8 effects rightward closing movement of the operating cylinder 25 and consequent contact re-engagement between the movable contact 26 and the relatively stationary contact 32. Reference may be had to U.S. Patent 3,114,815, issued December 17, 1963, to Robert L. Hess, James M. Telford and Gilbert J. Easley, and assigned to the assignee of the instant application, for a detailed description of the several structural parts of the circuit-interrupting structure 1. For the purpose of understanding the present invention, however, a description has only been included relating to the important parts of the contact-separating movement, and a description of the orifice structure 27, which has considerably benefited the operating performance of the breaker.

Although there has been illustrated and described a specific structure, it is to be clearly understood that the same was merely for the purpose of illustration, and that changes and modifications may readily be made therein by those skilled in the art, without departing from the spirit and scope of the invention.

I claim as my invention:

1. A single orifice structure for a gas-blast circuit interrupter including a generally cylindrically-shaped insulating member having a restricted orifice opening intermediate the ends thereof, lateral open venting means in the side wall of the orifice structure on the downstream side of the restricted orifice opening comprising at least four uniformly-spaced lateral vents, said venting means being disposed in immediate proximity to the restricted orifice opening, and the lateral open venting area being substantially one-half that of the restricted orifice opening.

2. The combination according to claim 1, wherein a plurality of spaced ribs are provided on the inner surface of the orifice structure downstream of the lateral open venting means.

3. A gas-blast circuit interrupter including a rod-shaped stationary contact and a cooperable movable contact, a movable single orifice structure movable with the movable contact and causing thereby an unplugging of the

rod-shaped stationary contact out of the restricted orifice opening, means for forcing a blast of gas through the restricted orifice opening in the direction of the stationary contact, and lateral open venting means in the side wall of the orifice structure on the downstream side of the restricted orifice opening comprising at least four uniformly-spaced lateral vents, said venting means being disposed in immediate proximity to the restricted orifice opening, and the lateral open venting area being substantially one-half that of the restricted orifice opening.

4. The combination according to claim 3, wherein a plurality of spaced ribs are provided on the inner surface of the orifice structure downstream of the lateral open venting means.

5. A puffer-type compressed-gas circuit interrupter including means defining a fixed piston, a movable operating cylinder carrying a movable contact and orifice structure slidable over said fixed piston to effect compression of gas, a stationary contact blocking a restricted throat portion provided intermediate the ends of the orifice structure, and at least four lateral round venting holes disposed contiguously to said throat portion and downstream of said throat portion and having a total venting area substantially one-half the venting area through the throat portion.

6. The combination according to claim 5, wherein annular spaced ribs are provided on the inner surface of the orifice structure adjacent the downstream free end thereof.

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